

***Chaerilus pseudoconchiformus* sp. n. and an updated key of the chaerilid scorpions from China (Scorpiones, Chaerilidae)**

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Abstract

A new species, *C. pseudoconchiformus* **sp. n.**, is described from Xizang, China. The new species is distinguished from its congeners by a body length of 32–40 mm, carapace with the anterior margin straight, chela with length/width ratio average of 3.3 in males (3.2–3.4, two adults), and 2.5 in females (2.3–2.6, nine adults), eight or nine (eight usually) rows of denticles on fixed and movable fingers of pedipalp chelae, five pectinal teeth in males and three or four in females. To date, the chaerilid species fauna of China consists of nine species. An updated identification key to *Chaerilus* from China is presented.

Keywords

Chaerilidae, *Chaerilus*, new species, Xizang, China

Introduction

The small monotypic family, Chaerilidae, has been reported containing one genus with 39 species (1/2015, <http://www.ntnu.no/ub/scorpion-files/>). The only genus is *Chaerilus*, which is found in southern and southeast Asia. In Xizang (Tibet), the chaerilid scorpions live under stones and fallen trees in humid habitats.

Chaerilid scorpions have a unique type B trichobothrial arrangement (Vachon 1974; Soleglad and Fet 2001). Kovařík (2000) reported 18 species in this genus in his review. Kovařík (2012) published an identification key for the genus. Recently, new species were described (Kovařík et al. 2014; Lourenço and Pham 2014).

Kovařík (2000) reported an old species and erected a new species of chaerilid from Xizang in his revision: *C. pictus* (Pocock, 1890) and *C. tryznai* Kovařík, 2000. In fact, one locality of *C. tricostatus* Pocock, 1899, Upper Rotung (Abor District), is also a territory belonging to Xizang (China). Therefore, Kovařík's revision recorded three species for China (Di et al. 2009). Zhu et al. (2004) recorded one chaerilid species (*C. pictus*) found in China. Qi et al. (2005) described one new species (*C. tessellatus* Qi, Zhu & Lourenço, 2005) and redescribed *C. pictus* (misidentification). Bastawade (2006) reported a new species from southeast Xizang: *C. dibangvalleycus* Bastawade, 2006. Zhu et al. (2008) redescribed *C. tessellatus* and *C. tryznai*, and pointed out that *C. pictus* as redescribed by Qi et al. (2005) was misidentified and erected it as a new species: *C. conchiformus* Zhu, Han & Lourenço, 2008. Zhu et al. (2008) also suggested that distribution of *C. pictus* in China was doubtful. Di and Zhu (2009) reported one new species: *C. mainlingensis* Di & Zhu, 2009. Di et al. (2009) reviewed the genus *Chaerilus* in China, registered seven species, and described the female of *C. tricostatus* for the first time. Kovařík (2012) described a new species from Xizang: *C. wrzecionkoi* Kovařík, 2012. Di et al. (2014) reviewed the research history of the order Scorpiones from China, and recorded eight chaerilid species. To date, the chaerilid fauna of China consists of nine species including the new species described in this paper, *C. pseudoconchiformus* sp. n.

Material and methods

Illustrations and measurements were made using a Motic K700 stereomicroscope with an Abbe drawing tube and an ocular micrometer. The photos were taken with a Canon (650D) camera. Measurements follow Sissom (1990) and are given in mm. Trichobothrial notations follow Vachon (1974) and morphological terminology mostly follows Hjelle (1990). Research materials have been deposited in the Specimen Room of University of Science and Technology of China, Hefei, China (USTC).

Taxonomy

Family Chaerilidae Pocock, 1893

Genus *Chaerilus* Simon, 1877

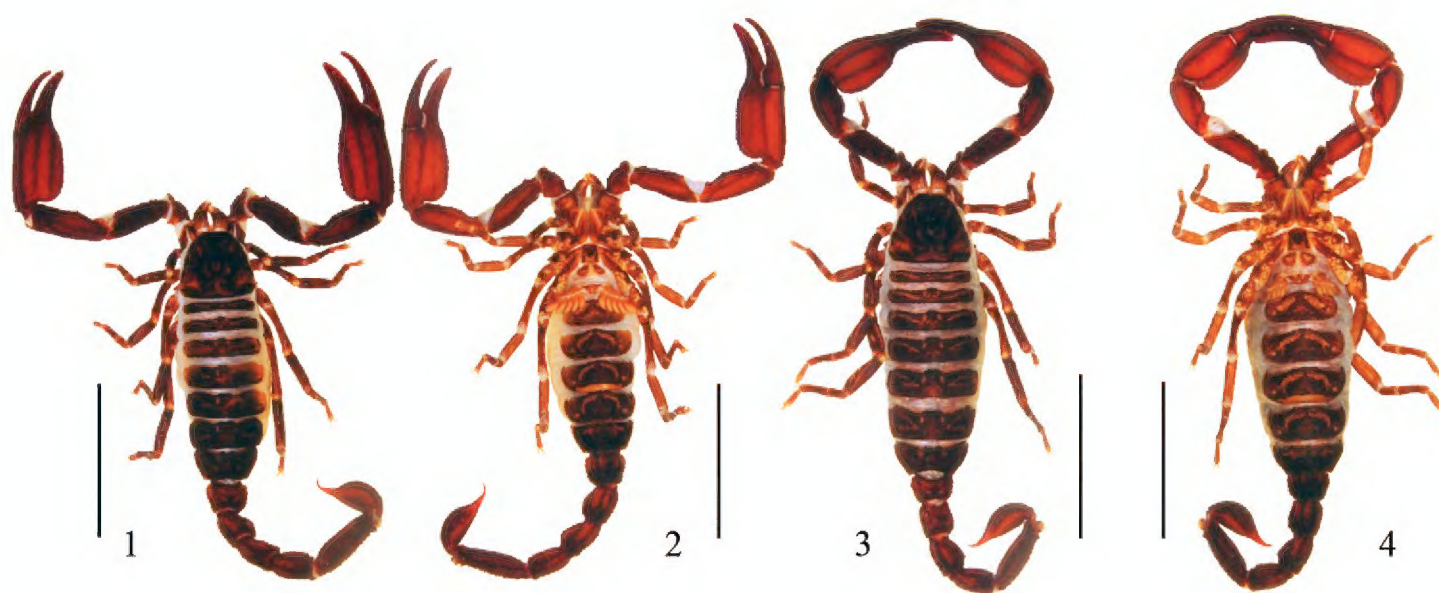
Chaerilus pseudoconchiformus sp. n.

<http://zoobank.org/569B23FC-86FB-4E16-8487-047B100BF9DC>

Figs 1–35, Tables 1–2

Type material. Holotype, male, China: Xizang, Nyingchi County (Linzhi County), VIII/2014, Zhiyong Di and Tao Li leg. (Ar.-USTC-XZLZ1401); paratypes: 1 adult male, 9 adult females, same data as holotype (Ar.-USTC-XZLZ1402–11) (kept in USTC).

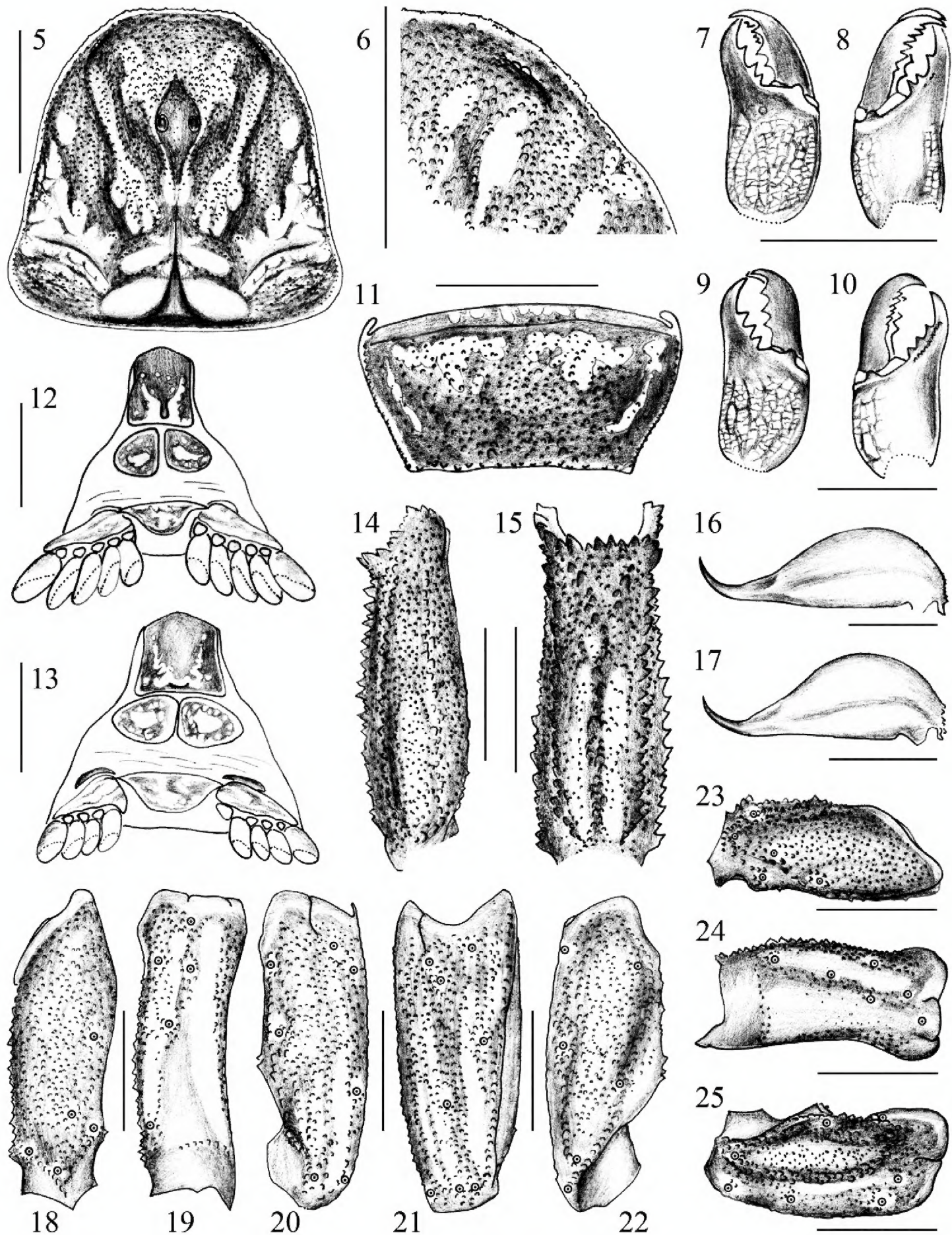
Diagnosis. The new species differs from other congeners by the following features: approximately 30–40 mm in total length (Table 2); carapace with the anterior margin straight; chela with length/width ratio: average of 3.3 in males, and 2.5 in females (Table 2); eight or nine (usually eight) rows of denticles on fixed and movable fingers of pedipalp chelae; five pectinal teeth in males and three or four in females. *Chaerilus pseudoconchiformus* sp. n. can be distinguished from the geographically and morphologically closely related species (Tables 2–3, and key). Morphologically closest are *C. conchiformus* and *C. wrzecionkoi*. Both these species have similar body lengths, as well as similar numbers of denticle rows on fixed and movable fingers of the pedipalp chelae. They can be distinguished by the length/width ratio of the pedipalp chela: manus of pedipalp in male narrow and long, chela length/width ratio in male higher than 3 (average of 3.3 in two males, and 2.5 in nine females) in *C. pseudoconchiformus* sp. n.; manus of pedipalp in male robust (Kovařík 2012: Fig. 68), chela length/width ratio in both sex adults lower than 2.6 in *C. wrzecionkoi* (Kovařík, 2012: 2); manus of pedipalp in both sex adults robust (Zhu et al. (2008): Figs 3, 17), chela length/width ratio in one male adult is 2.4 (paratype: Ar.-MHU-XZ0102), in two females (including the holotype) lower than 2.0 in *C. conchiformus*.



Figures 1–4. *C. pseudoconchiformus* sp. n., dorsal and ventral habitus: **1–2** Male holotype (Ar.-USTC-XZLZ1401) **3–4** Female paratype (Ar.-USTC-XZLZ1402). Scale bar = 10 mm.

Table 1. Measurements (mm) of *C. pseudoconchiformus* sp. n., male holotype (Ar.-USTC-XZLZ1401) and female paratype (Ar.-USTC-XZLZ1402). The information of *C. wrzecionkoi* from Kovařík (2012).

	<i>C. pseudoconchiformus</i> sp. n.		<i>C. wrzecionkoi</i>	
	Male holotype	Female paratype	Male holotype	Female paratype
Total length	37.4	37.1	37.0	39.0
Carapace:				
-Length	4.5	4.4	4.3	4.5
-Anterior width	2.4	2.7	4.4	5.1
-Posterior width	5.0	5.3		
Mesosomal segments:				
-Length	11.3	13.5		
Metasomal segment I:				
-Length	2.0	1.8	2.0	1.8
-Width	2.9	2.8	2.4	2.7
-Depth	2.1	2.1		
Metasomal segment II:				
-Length	2.6	2.2	2.4	2.2
-Width	2.4	2.4	2.0	2.2
-Depth	1.9	1.8		
Metasomal segment III :				
-Length	2.9	2.5	2.4	2.2
-Width	2.3	2.2	2.0	2.0
-Depth	1.7	1.8		
Metasomal segment IV:				
-Length	3.3	3.0	2.7	2.7
-Width	2.1	2.0	1.9	1.8
-Depth	1.6	1.6		
Metasomal segment V:				
-Length	5.4	4.9	4.7	4.4
-Width	1.9	1.8	1.8	1.6
-Depth	1.5	1.5		
Telson:				
-Length	5.5	4.8	4.9	4.9
-Width	2.1	2.0		
-Depth	1.7	1.7		
Pedipalp femur:				
-Length	5.4	4.1	4.5	3.7
-Width	1.8	1.7	1.6	1.7
-Depth	1.9	1.9		
Pedipalp patella:				
-Length	5.3	4.1	4.8	4.0
-Width	1.9	2.0	1.7	2.2
-Depth	2.1	2.4		
Chela:				
-Length	10.2	9.0	9.0	8.3
-Width (manus)	3.2	3.6	3.5	3.5
-Depth (manus)	3.1	3.1		
Movable finger:				
-Length	5.2	5.2	5.0	4.5
Pectinal teeth (left/right)	5/5	4/4	4/5	?



Figures 5–25. *C. pseudoconchiformus* sp. n. Male holotype: **5** Carapace, dorsal aspect **6** Lateral eyes area **7–8** Chelicera, dorsal and ventral aspects **11** Tegument of the seventh sternite; **12** Sternum, genital operculum and pectines **14–15** Metasomal segment V, lateral and ventral aspects **16** Telson **18–19** Femur, dorsal and external aspects **20–22** Patella, dorsal, external and ventral aspects. Female paratype (Ar.–USTC–XZLZ1402): **9–10** Chelicera, dorsal and ventral aspects **17** Telson **23–24** Femur, dorsal and external aspects **25** Patella, dorsal aspect. Scale bars = 2 mm.

Table 2. Feature datasets of body length (BL, mm; segment by segment was measured and added in type specimens, while others were measured for overall length only), chela with length/width ratio (CR), number of granule rows of movable finger of pedipalp (RN), and number of pectinal teeth (PT) of *C. conchiformus* (CO, Ar.-USTC-XZLZ1412), *C. pseudoconchiformus* sp. n., and *C. tryznai* (TY, Ar.-USTC-XZBM1401–02).

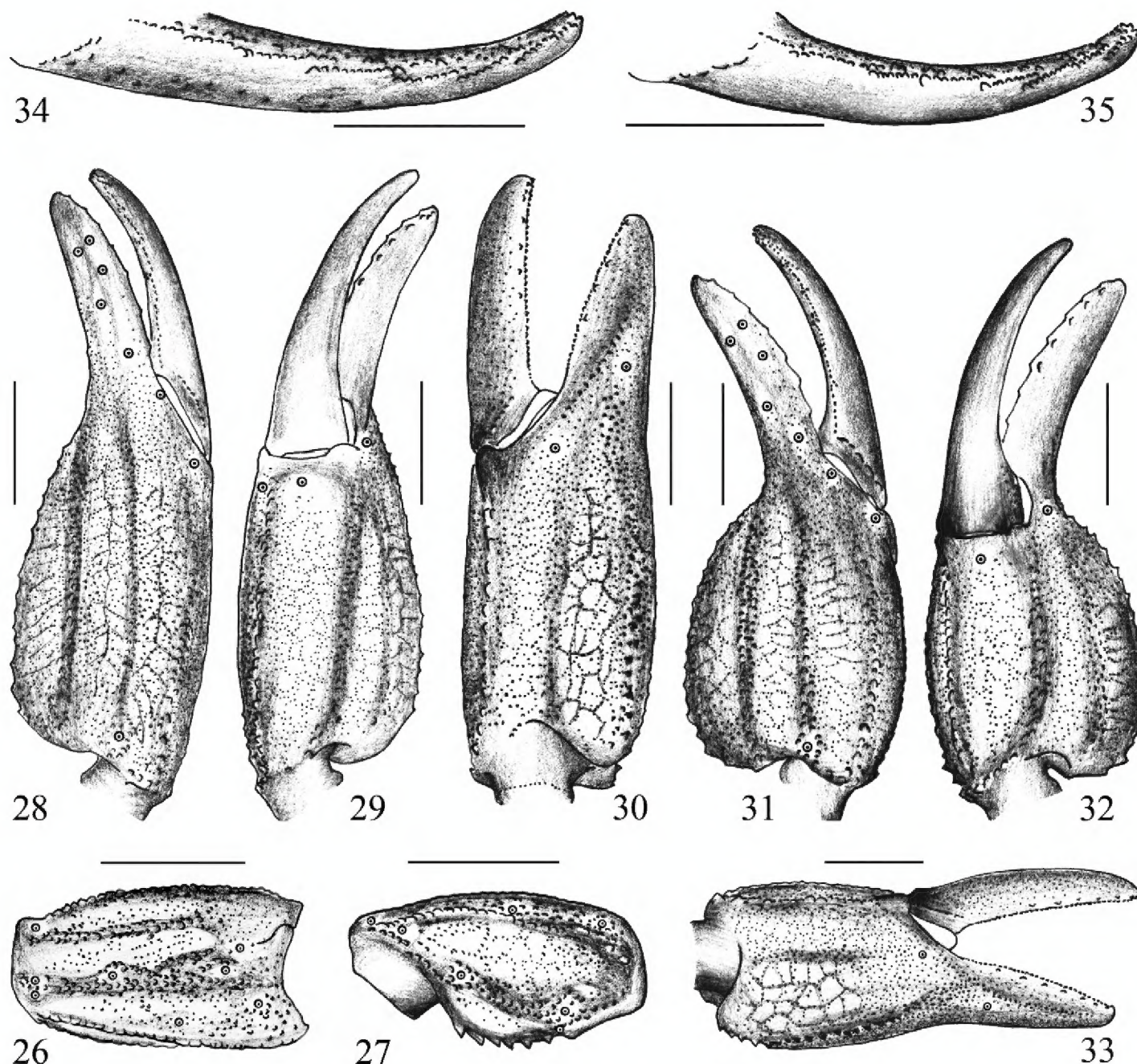
	Sex	BL	CR	RN	PT
XZLZ1401	♂	37.4	3.2	8/8	5/5
XZLZ1402	♀	37.1	2.5	8/8	4/4
XZLZ1403	♂	32.0	3.4	8/8	5/5
XZLZ1404	♀	36.0	2.5	8/8	4/4
XZLZ1405	♀	39.0	2.6	9/9	4/4
XZLZ1406	♀	32.5	2.4	8/8	3/3
XZLZ1407	♀	38.0	2.6	8/8	4/3
XZLZ1408	♀	37.0	2.3	8/8	3/3
XZLZ1409	♀	38.0	2.3	8/8	3/3
XZLZ1410	♀	37.0	2.5	8/8	4/3
XZLZ1411	♀	35.5	2.5	8/8	4/3
XZLZ1412(CO)	♀	32.0	1.9	7/7	4/4
XZBM1401(TY)	♀	44.0	2.8	8/8	3/3
XZBM1402(TY)	♀	39.0	2.6	8/8	3/3

mus. Furthermore, *C. pseudoconchiformus* sp. n. has more slender pedipalps than *C. wrzecionkoi* (Table 1; Kovařík 2012: 13), in other words, the length ratio of pedipalp (LRP) is distinctly larger than the length ratio of total length (LRT) of *C. pseudoconchiformus* sp. n. and *C. wrzecionkoi*: 1.14 (LRP), 1.01 (LRT) in male holotypes; 1.08 (LRP), 0.95 (LRT) in female allotypes of *C. pseudoconchiformus* sp. n. and *C. wrzecionkoi* (Table 1).

Etymology. The specific name refers to the geographically and morphologically most closely related species *C. conchiformus*, adding the Greek prefix “pseudo–” as “pseudoc-onchiformus”, because the habitus of both sexes is very similar to that of *C. conchiformus*.

Description. Based on male holotype and female paratype.
Coloration (Figs 1–4). Basically reddish brown. Carapace dark red-brown with black parts and yellowish stripes. Mesosomal tergites dark red-brown with yellowish stripes. Metasoma: all segments dark red-brown. Telson dark red-brown with reddish brown part; aculeus light red-brown. Chelicerae reddish brown with dark reticular pattern on dorsal surface. Pedipalps: femur, patella and chela dark red-brown with dark carinae. Legs dark red-brown and red-brown on distal segments. Sternum, genital operculum and sternites red-brown with some light parts. Pectines light yellow.

Morphology. Carapace carinated, with the anterior margin straight; with dense granules of nearly equal size; lateral furrow moderately deep; large granules form two longitudinal lateral carinae (Fig. 5). Median ocular tubercle with granules. Lateral ocular tubercle small with a pair of lateral eyes and some granules (Fig. 6). Lateral eyes distinctly smaller than median eyes (Fig. 5).



Figures 26–35. *C. pseudoconchiformus* sp. n. Male holotype: **28–30** Chela, dorsoexternal, ventral, and internal aspects **34** Movable finger of pedipalp. Female paratype (Ar.-USTC-XZLZ1402): **26–27** Patella, external and ventral aspects **31–33** Chela, dorsoexternal, ventral, and internal aspects **35** Movable finger of pedipalp. Scale bars = 2 mm.

Mesosoma: Tergites uniform distributing with granules of larger and unequal size; tergites I to II without carinae, each of tergites III to VI bearing a pairs of obsolete granular carinae on posterior margin, tergite VII bearing two pairs of obsolete granular lateral carinae, but middle pair is represented only by ridges without expressed carinae; sternum pentagonal; genital operculum triangular; pectinal teeth count 5/5 in males and 3–4 in females, with fulcra well developed (Figs 12–13); sternites III to VI are smooth, sternite VII granular without carinae (Fig. 11).

Metasoma: Length about 4.8 times as long as carapace in males and 4.4 in females; segment I always wider than long; segments I to V with 10-8-8-8-7 granular carinae; the ventromedian and ventrolateral carinae of segment V composed of strong, den- tated granules, ventromedian carina posteriorly bifurcated as “Y” (Figs 14–15); all

Table 3. The differences between of chaerilids from China: *C. conchiformis*, *C. dibangvalleycus*, *C. mainlingensis*, *C. pictus*, *C. pseudoconchiformis* sp. n., *C. wrze-
cionkoi*, *C. tessellatus*, *C. tricostatus*, and *C. tryznai*; body length (BL, mm); carapace with the anterior margin (straight or curving, CA); chela with length/width ratio
respectively in females and males (CR(F), CR(M)), dorsal secondary carinae of the chela (DS); rows number of denticles on fixed and movable fingers of chelae (RF);
the tegument of the seventh sternite (SVII); holotype (H), paratype (P), new material (N).

	<i>conchiformis</i> (H&N)	<i>dibangvalleycus</i> (H&P)	<i>mainlingensis</i> (H&P)	<i>pictus</i> (H&P)	<i>pseudocon- chiformis</i> sp. n. (H&P)	<i>wrzezionkoi</i> (H&P)	<i>tessellatus</i> (H&P)	<i>tricostatus</i> (N)	<i>tryznai</i> (H, P&N)
BL	32–44	36–42	40–41	38–66	32–39	33–41	35–52	48–60	30–44
CA	straight	slightly curving	slightly depressed	slightly curving	straight	straight	straight	straight	straight
CR(F)	1.8–1.9	?	2.4–2.8	2.4	2.3–2.6	2.4	2.2	2.2–2.4	2.6–2.9
CR(M)	?	?	?	2.5	3.2–3.4	2.6	?	3.7	>3
DS	present	absent	absent	present	present	present	present	absent	present
RF	8	7 or 8* ¹	7	13 or 14	8 or 9	8(9?) * ²	11	11 or 12	8
SVII	weakly granular; with carinae	granular; with carinae	weakly granular; with carinae	?	granular; without carinae	granular; without carinae	with carinae	granular; with carinae	granular; without carinae

*¹ Nine rows of denticles on fixed and movable fingers of pedipalp chelae in the holotype (Bastawade 2006: Fig. 5). But the author thought that there are seven or eight rows in *C. dibangvalleycus* and 10–11 in *C. tricostatus* (Bastawade 2006: 454).

*² Nine rows of denticles on movable fingers of pedipalp chelae in the holotype (Kovářík 2012: Fig. 64), but the author described eight rows in *C. wrzezionkoi* (Kovářík 2012: 11).

segments with sparse small granules. Vesicle is almost smooth; aculeus slightly curved (Figs 16–17).

Chelicerae: Tibia surfaces smooth; thickly covered with numerous short, silky hairs, extending to ventral aspect of chelicerae and dorsal aspect of fixed fingers; ventral inner edges of movable finger with some minute teeth (2–3 obsolete teeth in two males and 3–9 well developed and obsolete teeth in nine females) (Figs 7–10).

Pedipalp: Tegument granular. The femur has four carinae and the patella has five granular carinae (Figs 18–27). Chela with length/width ratio average of 3.3 in males (two adults) and 2.5 in females (nine adults), has seven granulated dorsointernal, except internal carina obsolete; entire tegument of chela manus densely covered with coarse granules, forming some indistinct reticular pattern (Figs 28–33); fingers straight, the cutting edge of movable finger with 8 or 9 (mainly 8) rows of denticles (Figs 34–35). Trichobothriotaxy of type B; orthobothriotaxic (Vachon 1974) (Figs 18–33).

Legs: Tibia without tibial spur. Basitarsus with two pedal spurs strongly developed. Tarsi with two rows of spiniform setae.

Variation. Coloration and morphology in holotype and paratypes are very similar (feature datasets please see Table 2).

Habitat. Found under the stones in mixed forest.

Distribution. China (Xizang).

Update key to species of the genus *Chaerilus* in China

- | | | |
|---|--|----------------------------------|
| 1 | Movable finger of pedipalp with 7–9 rows of granules | 2 |
| – | Movable finger of pedipalp with 10–14 rows of granules | 7 |
| 2 | Chela length to width ratio in female adults 1.6–1.9 | <i>C. conchiformus</i> |
| – | Chela length to width ratio in female adults higher than 2.0..... | 3 |
| 3 | Ventral side of seventh mesosomal segment with 2 pairs of granular carinae; carapace with anterior margin straight with a median notch | 4 |
| – | Ventral side of seventh mesosomal segment with many granules but without carinae; carapace with anterior margin straight without median notch..... | 5 |
| 4 | Pedipalp femur shorter than carapace; 8–9 minute teeth on inner ventral margins of movable and immovable fingers respectively (Bastawade 2006: 451, fig. 5) | <i>C. dibangvalleycus</i> |
| – | Pedipalp femur longer than carapace, 7–8 minute teeth on inner ventral margins of movable and immovable fingers respectively (Di and Zhu 2009: 101, fig. 11) | <i>C. mainlingensis</i> |
| 5 | Manus of pedipalp narrower and longer with the ventral margin not round in females (Zhu et al. 2008: fig. 47); chela length/width ratio in females is 2.6–2.9 (Kovářík 2000: table 1)..... | <i>C. tryznai</i> |
| – | Manus of pedipalp robust in females with the ventral margin very round in females; chela length/width ratio in females is 2.3–2.6..... | 6 |

- 6 Chela length/width ratio in males average of 3.3 (3.2–3.4), and 2.5 in females (2.3–2.6), chelae of male and female with sexual dimorphism *C. pseudoconchiformus* sp. n.
- Chela length/width ratio about 2.6 in male, and about 2.4 in female, chelae of male and female without sexual dimorphism (Kovářík 2012: 13, figs 62, 76) *C. wrzecionkoi*
- 7 Movable finger of pedipalp with 13–14 rows of granules; telson of male rather long and about 4.7 times longer than wide, with an obvious sexual dimorphism in both sexes..... *C. pictus*
- Movable finger of pedipalp with 11–12 rows of granules; telsons of male and female without sexual dimorphism 8
- 8 Carapace and tergites nearly smooth in adults (Zhu et al. 2008: 44, 47) *C. tessellatus*
- Carapace and tergites with many big granules in adults (Di et al. 2009: 133, 136) *C. tricostatus*

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